water temperatures
- Determine the flows necessary to transport and cleanse spawning gravels

ACTION 3: Develop and implement a watershed management plan to reduce the amount of fine sediments introduced to the creek channel, to protect and restore riparian habitat to improve base flows, and to reduce water temperatures.

RATIONALE: Activities in the Butte Creek watershed can increase erosion rates and introduce excessive loads of fine sediments to the creek channel. Untimely pulses of fine sediments can clog or bury spawning gravels, suffocating the incubating eggs of anadromous fish or preventing salmonid fry from emerging from the gravels. Fine sediments can also fill in the deep-water pools that adult spring-run chinook salmon and steelhead trout require to survive high summer temperatures. Developing a watershed management plan to manage road construction, timber harvest and cattle grazing in the watershed can help prevent the introduction of too many fine sediments to the creek channel. Managing the fuel load in the watershed can also help prevent catastrophic wildfires that can denude vast areas of vegetation.

Developing a watershed management plan that protects and restores riparian vegetation can provide several ecological benefits. In addition to providing habitat for a variety of wildlife species, riparian buffers can help to trap fine sediments from reaching the stream channel. Riparian vegetation can also help reduce stream temperatures by providing shading, especially for pools that adult spring-run chinook salmon and steelhead trout use for holding during the summer. Riparian vegetation also helps create cutbanks that provide important rearing habitat for juvenile salmonids. Riparian vegetation also provides nutrients and woody debris to the creek channel, helping to stimulate food production and to provide diverse aquatic habitat.

Riparian vegetation can also help to retain stormwater runoff, helping to reduce peak flows in the channel and the concomitant flood risk to downstream reaches. Retention of stormwater runoff can also help increase the amount of water that percolates into groundwater aquifers, which can in turn help to increase groundwater discharge to the stream channel that enhances base flows and helps reduce water temperatures.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- determine the relative contribution of fine sediments to the channel from natural and human disturbances in the watershed
- evaluate how the restoration of upland and riparian habitat affects the transport of fine sediments to the stream channel
- as riparian vegetation is restored, evaluate the volume of stormwater runoff retained, rates of water percolation to groundwater, and groundwater discharge to the channel during base flow
- as riparian vegetation is restored, evaluate its effects upon water temperatures.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

FY '97 and FY '98 CALFED Restoration Coordination Program funds have been provided for the acquisition and restoration of riparian habitat along Butte Creek as well as watershed planning. Earlier Category III funds were provided for the development of the Butte Creek Watershed Management Strategy.

BIG CHICO CREEK

ACTION 1: Develop and implement a watershed management plan to reduce the amount of fine sediments introduced to the creek channel, to protect and restore riparian habitat, to improve base flows, to reduce water temperatures, and to balance recreational uses with plant and wildlife requirements.

RATIONALE: Activities in the Big Chico Creek watershed can increase erosion rates and introduce excessive loads of fine sediments to the creek channel. Untimely pulses of fine sediments can clog or bury spawning gravels, suffocating the incubating eggs of anadromous fish or preventing salmonid fry from emerging from the gravels. Fine sediments can also fill in the deep water pools that adult spring-run chinook salmon and steelhead

trout require to survive high summer temperatures. Developing a watershed management plan to manage road construction, timber harvest and cattle grazing in the watershed can help prevent the introduction of too many fine sediments to the creek channel. Managing the fuel load in the watershed can also help prevent catastrophic wildfires that can denude vast areas of vegetation.

The Big Chico Alliance is developing a watershed management plan for protecting and restoring riparian vegetation to provide several ecological benefits. In addition to providing habitat for a variety of wildlife species, riparian buffers can help to trap fine sediments from reaching the stream channel. Riparian vegetation can also help reduce stream temperatures by providing shading, especially for pools that adult spring-run chinook salmon and steelhead trout use for holding during the summer. Riparian vegetation also helps create cutbanks that provide important rearing habitat for juvenile salmonids. Riparian vegetation also provides nutrients and woody debris to the creek channel, helping to stimulate food production and to provide diverse aquatic habitat.

Riparian vegetation can also help to retain stormwater runoff, helping to reduce peak flows in the channel and the concomitant flood risk to downstream reaches. Retention of stormwater runoff can also help increase the amount of water that percolates into groundwater aquifers, which can in turn help to increase groundwater discharge to the stream channel that enhances base flows.

Existing and future recreational uses of Big Chico Creek must be balanced with the needs of plant and animal species. Recreational areas should be located away from sensitive or important fish habitat.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

FY '97 CALFED Restoration Coordination Program funds were provided to help develop the Big Chico Watershed Plan. The Big Chico Watershed Alliance is facilitating the development of this plan and is hosting a series of public workshops to prioritize watershed goals and issues and concerns.

FEATHER RIVER STAGE 1 ACTIONS

ACTION 1: Screen the Sunset Pumps diversion to prevent entrainment of juvenile salmonids.

RATIONALE: Several species of anadromous fish spawn in the Feather River. Juvenile salmonids attempting to emigrate from the river can be entrained by unscreened or poorly screened diversions. Upgrading the Sunset Pumps diversion screens will help reduce entrainment losses for several species of anadromous fish.

ACTION 2: Improve hatchery management and release practices at the Feather River Hatchery to better protect the genetic integrity of wild anadromous fish populations.

RATIONALE: Fish hatcheries in the Central Valley help to mitigate for fisheries losses attributed to dams that block access to historical spawning grounds and the degradation of habitat. Hatcheries can provide a valuable function by helping to maintain commercial and sport fisheries and by augmenting wild populations of fish that decline during adverse conditions such as droughts, thereby helping to ensure the survival of the species. However, hatchery produced fish can compete with wild populations for available resources such as food and spawning and rearing habitat. Hatchery produced fish may also prey upon wild populations of juvenile anadromous fish. The selection of fish used as hatchery stock may not represent an appropriate cross section of the population, which can reduce genetic diversity. Hatchery-produced fish also spawn with wild populations, reducing threatening the genetic integrity of wild populations of fish.

Reducing the number of hatchery-produced fish released into Bay-Delta tributaries in years when the natural production of fish is high can help prevent competition among wild and hatchery-reared fish and help populations of wild fish to rebound naturally. It can also help to reduce inter-breeding and the genetic contamination of the wild population. Selecting an appropriate cross section of adult spawners can also help to preserve genetic diversity in the species. Tagging hatchery-produced fish could allow for selective commercial

and sport fishery harvest, reducing the impacts of harvest upon wild populations of fish.

YUBA RIVER STAGE 1 ACTIONS

ACTION 1: Evaluate options to improve fish passage upstream and downstream of Daguerre Point Dam. Conduct a feasibility study of removing or modifying Daguerre Point Dam.

RATIONALE: Daguerre Point Dam is a debris dam constructed primarily to trap excessive sediment caused by upstream mining operations. The dam can delay or impede the upstream migration of adult anadromous fish, thereby reducing reproductive success. The dam has been equipped with fish ladders in the past, but their success in providing access has been minimal. The dam can also disrupt the downstream migration of emigrating juvenile salmonids, which are subject to predation by non-native and invasive fish species in the warm water habitat created by the dam's impoundment of water. Removing the dam could improve access to nearly 12.5 miles of river channel and reduce predation losses of juvenile anadromous fish.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- If it is feasible to remove Daguerre Point Dam, compare escapement rates and use of spawning habitat upstream of the dam before and after removal.
- Compare rates of predation of juvenile anadromous fish downstream of the dam before and after removal.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

There is a potential future linkage with the Comprehensive Study.

ACTION 2: Evaluate options to reintroduce steelhead and spring-run chinook salmon upstream of Englebright Dam.

RATIONALE: Englebright Dam is a debris dam constructed primarily to trap excessive sediment caused by upstream mining operations, though the dam also provides for important re-regulation of hydropower releases from upstream reservoirs. The dam is currently the upstream limit of anadromous fish migration. The feasibility study would need to evaluate the potential quantity and quality of upstream habitat that would be provided, as well as the potential mercury contamination of sediments behind Englebright Dam.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate the suitability of upstream habitats.
- Evaluate mercury levels in the sediments behind the dam.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

There is a potential future linkage with the Comprehensive Study.

AMERICAN RIVER STAGE 1 ACTIONS

ACTION 1: Control or eradicate non-native riparian plants and re-vegetate with native plants.

RATIONALE: *Arundo donax* (giant reed) has become established in the American River. Arundo can alter ecological processes by inducing greater deposition, by evapotranspiring greater quantities of water than native riparian vegetation, and by altering soil chemistry. Arundo provides little habitat for native wildlife species, and because it grows vertically and doesn't overhang the stream channel, it doesn't provide the SRA habitat for aquatic species that native riparian vegetation does. Replacing Arundo with native riparian vegetation may also enhance base flows. Another non-native plants of concern is scarlet wisteria.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate different removal and re-vegetation techniques to identify the most effective and cost-effective methods for controlling or eradicating non-native or invasive riparian plant species.
- Monitor the rate of re-colonization by native, non-native, and invasive species.
- Determine the ecological conditions or processes that favor native species over non-native species.

- Determine invertebrate and wildlife use of non-native riparian plant species.
- Determine the extent to which non-native riparian species alter ecological processes.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

SWRCB funds have been provided for erosion and sediment control demonstration project on Cache Creek.

ACTION 2: In balance with public safety, manage the removal of or introduce instream woody debris on selected river reaches to enhance aquatic habitat for salmonids.

RATIONALE: Woody debris is cleared from the American River channel for recreational and public safety purposes. However, woody debris provides important rearing and resting habitat for salmonids. Allowing woody debris to stay in selected reaches of the channel may enhance patches of salmonid rearing habitat without affecting recreation significantly.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Compare salmonid use of aquatic habitat in reaches with woody debris and reaches cleared of woody debris.

ACTION 3: Improve hatchery management and release practices at the Nimbus Hatchery to better protect the genetic integrity of wild anadromous fish populations.

RATIONALE: Fish hatcheries in the Central Valley help to mitigate for fisheries losses attributed to dams that block access to historical spawning grounds and the degradation of habitat. Hatcheries can provide a valuable function by helping to maintain commercial and sport fisheries and by augmenting wild populations of fish that decline during adverse conditions such as droughts, thereby helping to ensure the survival of the species. However, hatchery produced fish can compete with wild populations for available resources such as food and spawning and rearing habitat. Hatchery produced fish may also prey upon wild populations of juvenile anadromous fish. The selection of fish used as hatchery stock may not represent an appropriate cross section of the population, which can reduce genetic diversity. Hatchery-produced fish also spawn with wild populations, reducing threatening the genetic integrity of wild populations of fish.

Reducing the number of hatchery-produced fish released into Bay-Delta tributaries in years when the natural production of fish is high can help prevent competition among wild and hatchery-reared fish and help populations of wild fish to rebound naturally. It can also help to reduce inter-breeding and the genetic contamination of the wild population. Selecting an appropriate cross section of adult spawners can also help to preserve genetic diversity in the species. Tagging hatchery-produced fish could allow for selective commercial and sport fishery harvest, reducing the impacts of harvest upon wild populations of fish.

CACHE CREEK STAGE 1 ACTIONS

ACTION 1: Control or eradicate non-native riparian plants and re-vegetate with native plants.

RATIONALE: Tamarisk has become established in the Cache Creek watershed. Tamarisk can alter ecological processes by inducing greater deposition, by evapotranspiring greater quantities of water than native riparian vegetation, and by altering soil chemistry. Tamarisk provides little habitat for native wildlife species, and because it grows vertically and doesn't overhang the stream channel, it doesn't provide the SRA habitat for aquatic species that native riparian vegetation does. Controlling or eradicating tamarisk from the Cache Creek watershed will help prevent its spread into Yolo Bypass and the Delta. Replacing tamarisk with native riparian vegetation may also enhance base flows.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate different removal and re-vegetation techniques to identify the most effective and cost-effective methods for controlling or eradicating non-native or invasive riparian plant species.
- Monitor the rate of re-colonization by native,

non-native, and invasive species.

- Determine the ecological conditions or processes that favor native species over non-native species.
- Determine invertebrate and wildlife use of non-native riparian plant species.
- Determine the extent to which non-native riparian species alter ecological processes.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

SWRCB Proposition 204 funds have been provided for a demonstration project to control soil erosion in the Cache Creek watershed to help prevent the release of contaminants into the stream channel.

GENERAL SACRAMENTO BASIN STAGE 1 ACTIONS

ACTION 1: Restore seasonal wetlands and encourage wildlife-friendly agricultural practices to support the Central Valley Habitat Joint Venture restoration goals for resident and migratory birds in Sutter, Colusa, Butte, and American Basins.

RATIONALE: The ERP embraces the goals of the Central Valley Habitat Joint Venture, which has a goal of protecting, enhancing, and restoring seasonal wetlands for the benefit of migratory bird species. The ERP will focus on actions to enhance existing but degraded seasonal wetland habitat and in promoting wildlife-friendly agricultural practices.

ACTION 2: Acquire at least 100,000 acre-feet of water from willing sellers for environmental uses in the Sacramento Basin, San Joaquin Basin and the Delta. (Note: action also listed as San Joaquin Basin action.)

RATIONALE: Alteration of the flow regime in Bay-Delta tributaries and changes in Bay-Delta hydrodynamics have contributed to ecosystem degradation. Purchasing water from willing sellers will provide water that can be used to:

- Provide passage flows for adult anadromous fish;
- Provide pulse flows for emigrating juvenile salmonids;
- Improve habitat conditions by reducing water temperatures;
- Prevent diversion effects on fish through exchange agreements with diverters;
- Provide flushing flows to maintain the quality of aquatic habitat;
- Provide flows for riparian habitat maintenance, regeneration, and succession;
- Provide flows to inundate floodplains.

This 100 TAF is not a part of CVPIA flows; rather, it is additional water necessary to meet the broader objectives of the CALFED Ecosystem Restoration Program and will be coordinated with the Environmental Water Account.

DRAFT SAN JOAQUIN RIVER BASIN STAGE 1 ACTIONS

SAN JOAQUIN RIVER BASIN DESCRIPTION

The San Joaquin River and its tributaries are an important component of the Bay-Delta ecosystem. The tributaries in the basin can be restored to provide important spawning, rearing, nesting, and wintering habitat for a variety of species.

Factors most influencing the ecological health of tributaries in the San Joaquin River Basin include:

1. Reductions in the magnitude, frequency, duration, and variability of river flows because of dam construction and diversions.

2. Reductions in the amount of coarse sediment available to create and maintain important aquatic and riparian habitat because of dam construction, aggregate mining in active river channels, and relatively narrow levees that increase shear stress applied to channel bed sediments.

3. Disruption of sediment transport and expansion of habitat that favors non-native and invasive species from excavation pits formed by aggregate mining operations.

4. Reductions in the amount and contiguity of riparian habitat because of urban and agricultural encroachment and levee construction.

5. Elevated water temperatures because of dam construction, diversions, return flows, captured excavation pits, and the loss of riparian habitat.

6. Degradation of spawning and rearing habitat because of excessive loads of fine sediments and urban, industrial, and agricultural discharges of pollutants.

7. Loss of river-floodplain interactions because of levee construction.

STAGE 1 APPROACH

Since most of the tributaries in the San Joaquin River basin are regulated by large dams, it will be necessary to conduct targeted research and to monitor Stage 1 actions to determine the optimal combinations of flow and sediment that will best restore aquatic and riparian habitat in light of the regulated flow regime.

The primary species that will benefit from Stage 1 actions implemented in the San Joaquin River basin are fall-run chinook salmon.

Stage 1 actions also focus on the Tuolumne River as a demonstration stream. The objective for each demonstration stream is to fully restore the tributary within existing constraints (such as large dams) so that each becomes a healthy, resilient haven of continuous riparian and aquatic habitat to optimize endemic plant and animal populations. Restoring the Tuolumne River into a healthy riparian corridor during Stage 1 will help recover and maintain large populations of fall-run chinook salmon to endure severe ecological conditions such as droughts. The Tuolumne River was selected as a demonstration stream because it generally offers the best habitat conditions in the basin for fall-run chinook salmon, and it has a well-organized stakeholder group to help implement restoration actions.

TUOLUMNE RIVER STAGE 1 ACTIONS

The Tuolumne River has potential to be a demonstration stream representative of tributaries of the San Joaquin Basin. Demonstration watersheds will be selected for large-scale implementation of restoration actions to significantly restore ecological processes and resources while simultaneously testing restoration hypotheses as part of an adaptive management approach. Lessons learned restoring the Tuolumne River will help the design and refinement of future restoration actions on the Tuolumne River and other Bay-Delta tributaries.

The Tuolumne has potential to be a demonstration stream for several reasons. It generally has the highest volume of inflow (1.9 MAF) of the three tributaries to the San Joaquin River; therefore it generally provides greater opportunity to release flows for ecological benefits. Historically, the Tuolumne River also contributed a larger percentage to Central Valley salmon escapement than the other tributaries to the San Joaquin River, so emphasizing restoration in this river has the potential to provide more benefits to stabilizing populations of anadromous fish. The Tuolumne River also has an organized watershed group, Tuolumne River Technical Advisory Committee (TRTAC), to facilitate implementation of restoration actions. TRTAC has already begun preparing the site-specific environmental documentation and acquiring permits for several restoration actions; consequently, it may be feasible to implement a larger number of actions in the first seven years of implementation as compared to other watersheds.

ACTION 1: Fill in in-channel excavation pits.

RATIONALE: Past aggregate mining operations excavated deep pits in the Tuolumne River channel. The size of the excavation pits reduces the velocity of water flow and increases ambient water temperatures, creating conditions that favor both non-native (large- and small-mouth bass) and native (Sacramento pikeminnow) species that prey upon juvenile anadromous fish. Since most of the spawning habitat for anadromous fish in the Tuolumne River is located upstream of these

excavation pits, juvenile anadromous fish emigrating to the Bay-Delta and ocean are subject to increased risk of predation. The excavation pits also serve as sediment traps by capturing coarse bedload material transported from upstream reaches, thereby depriving downstream reaches of important spawning gravels. Filling in the excavation pits will eliminate habitat that favors non-native or invasive fish species and reduce the risk of predation upon juvenile anadromous fish, and it will also be a prerequisite to restoring sediment transport processes

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- As in-channel excavation pits are filled in, monitor the number of large-mouth bass (the principal predator for juvenile anadromous fish) and the number of juvenile anadromous fish that escape from the river to help assess the relative effect of predation upon population size.
- Monitor ambient water temperatures to assess the relative contribution of excavation pits to elevated water temperatures in the Tuolumne River.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED Restoration Coordination funds have been provided to fill one of the larger instream excavation pits on the Tuolumne River.

ACTION 2: Fill in floodplain excavation pits and remove or setback protective berms and levees that isolate floodplain excavation operations.

RATIONALE: Aggregate mining activities on floodplains of the Tuolumne River excavate deep pits that are usually separated from the main river channel by relatively narrow berms and levees. Relatively moderate flood flows can breach these protective levees and berms, allowing the river to capture the floodplain pits that provide habitat for non-native and invasive fish species that prey upon juvenile anadromous fish. The berms and levees that isolate floodplain excavation pits from the main river channel can also concentrate flows and increase the shear stress applied to the channel bed, thus scouring important spawning gravels and incising the channel. Filling floodplain excavation pits in danger of being captured by peak flows will help eliminate potential habitat for non-native and invasive fish species that prey upon juvenile anadromous fish. Filling the pits will also allow confining levees and berms to be removed or set back, which will re-connect the river with a portion of its floodplain, thereby increasing flood storage and conveyance capacity and providing room for the river channel to meander. Removing or setting back the protective levees and berms will also reduce shear stress on the channel bed and help prevent spawning gravels from being flushed from the system. Strengthening setback levees and berms will also help to better protect continuing aggregate mining operations.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Monitor the availability and distribution of spawning-sized gravel in reaches where levees are removed or set back.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED Restoration Coordination funds have been provided to fill floodplain excavation pits and to set back protective levees and berms along one section of the Mining Reach of the Tuolumne River.

ACTION 3: Introduce spawning-sized gravel to the Tuolumne River channel.

RATIONALE: Dams in the Tuolumne River watershed trap all of the gravel derived from upstream reaches, thereby depriving downstream reaches of important material required to maintain aquatic and riparian habitat. Introducing spawning-sized gravel into the river channel will help to improve and increase the amount of spawning habitat available for anadromous fish by compensating for the coarse sediment load trapped behind dams.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Restoring spawning habitat in the river will likely require the introduction of a large supply of spawning-sized gravel initially to

compensate for past deficits caused by sediment trapping behind dams and past aggregate mining activities in the active channel. It will be necessary to determine the amount of gravel required for this initial infusion of gravel in light of the regulated flow regime of the river.

- Long-term river management will require balancing the river's sediment budget in light of the regulated flow regime of the river, which will require periodic infusions of gravel to compensate for sediment trapped behind dams. It will be necessary to determine the amount of gravel to be introduced periodically, as well as a schedule for gravel augmentation, to restore the river's sediment budget.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED Restoration Coordination funds have been provided to place spawning-sized gravel in the Tuolumne River channel between La Grange Dam and Basso Bridge.

ACTION 4: Purchase flood easements or floodplain land from willing sellers.

RATIONALE: Re-connecting the river channel with a portion of its floodplain can provide several ecological benefits. In conjunction with sufficient flows to mobilize fine sediments, restored floodplains can trap fine sediments, thereby preventing them from being stored in the river channel where they can degrade spawning habitat. Floodplains also contribute woody debris and organic material to the river channel, helping to create diverse aquatic habitat and to stimulate food web production. The purchase of flood easements or floodplain lands can also provide room for the river to meander by eliminating or setting back levees and by eliminating bank protection activities that degrade riparian habitat. The purchase of conservation easements or floodplain land can also allow the protection and restoration of riparian habitat.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Monitor floodplain storage of flood flows.
- Monitor the introduction of nutrients and organic material to the channel downstream of restored floodplains.
- Compare groundwater levels and groundwater discharges to the channel in reaches with restored floodplains with reaches confined by relatively narrow levees.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

CALFED Restoration Coordination funds have been provided to purchase 42 acres of floodplain land and a conservation easement on 140 acres of floodplain land on the Tuolumne River downstream of La Grange Dam to protect riparian habitat.

ACTION 5: Purchase water from willing sellers to increase the magnitude of fall flows. (Note: this water will be part of the 100 TAF of water purchased to improve stream flows in the Sacramento and San Joaquin Basins.)

RATIONALE: The Tuolumne River contributes a significant portion of the Central Valley's fall-run chinook salmon. The FERC Settlement Agreement for the New Don Pedro Project establishes a schedule for releasing minimum streamflows throughout the year, based upon the type of water year. Scheduled releases during the adult migration period include a 2-3 day attraction pulse flow (except in critically dry and dry water years) followed by fall base flows ranging from 100 cfs in critically dry water years to 300 cfs in above normal and wet water years. The superimposition of redds—the creation of spawning nests on top of already created spawning nests—suggest that the fall base flows are inadequate to distribute spawning throughout the channel, especially in dry and critically dry years. Increasing fall base flows by purchasing water from willing sellers will expand the wetted perimeter of the channel and make more aquatic habitat available for spawning. It will also allow fall-run chinook salmon to use spawning gravels located further away from the center of flow in the channel (the thalweg), which will make the redds less susceptible to scour during moderate floods while the eggs are incubating.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- As fall base flows are increased, monitor the rate of redd superimposition and the distribution of spawning habitat used.
- Monitor the proportion of redds scoured by moderate floods.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

The FERC Settlement Agreement has established a schedule of minimum flow releases based upon the type of water year, which has increased the amount of flow released to the lower Tuolumne River and helped to improve habitat conditions.

ACTION 6: Explore actions to reduce ambient water temperatures, including increasing flows by purchasing water from willing sellers or developing new water supplies, as well as protecting and restoring riparian habitat.

RATIONALE: Elevated ambient water temperatures in the Tuolumne River can be stressful or lethal to the early life stages of anadromous fish. Filling or isolating instream and floodplain excavation pits will help to reduce ambient water temperatures, but additional measures may be necessary to further reduce water temperatures. Purchasing water from willing sellers or developing new water supplies will allow increasing flows to reduce water temperatures during periods of egg incubation and juvenile anadromous fish emigration. Protecting and restoring riparian habitat will also help to increase the amount of shaded pool habitat, which is important temperature refugia for juvenile anadromous fish.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Evaluate the effectiveness of filling or isolating excavation pits on ambient water temperatures and determine if they are still stressful or lethal to anadromous fish.
- Evaluate the role of temperature refugia created by riparian habitat in reducing the effects of elevated water temperatures on anadromous fish.
- Evaluate the relative contribution of agricultural return flows upon elevated water temperatures.
- Evaluate the effectiveness of increased groundwater discharge associated with restored floodplains upon elevated water temperatures.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

The Vernalis Adaptive Management Program (VAMP) includes provisions to release water from San Joaquin River tributaries to evaluate the effects of flow upon San Joaquin River water quality.

ACTION 7: Evaluate entrainment rates at small diversions and assess their affect upon population size of native and anadromous fish.

RATIONALE: DFG has identified 36 diversions on the lower Tuolumne River; however, it is unknown if these diversions significantly affect, both individually and cumulatively, the population size of anadromous fish species. Evaluating entrainment rates at these small diversions will help assess their relative impact upon populations of anadromous fish species. If it is determined that the individual or cumulative impact of these diversions is significant, then ERP managers will work with willing local diverters to change the timing of diversions and to evaluate its effectiveness in reducing entrainment rates. If these diversions still produce a significant individual or cumulative impact upon fish populations, then ERP managers will work with willing diverters to consolidate, relocate, or screen the diversions.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Determine the individual and cumulative effects of diversions upon population size of fish species.
- Evaluate the effectiveness of changing the timing of diversions upon reducing entrainment rates.
- Evaluate the effectiveness of consolidating diversions or relocating diversions to areas less sensitive to fish species.

ACTION 8: Increase enforcement to reduce illegal harvest of fish.

RATIONALE: Several factors affect the population

of adult anadromous fish that return to the Tuolumne River to spawn each year, including hydrologic conditions in previous years, ocean conditions, and harvest rates. Illegal harvest of fish reduces the number of adult spawners. Especially during years when the population of adult spawners is already low, poaching can constitute a significant threat to the viability of a species. Increasing enforcement can help discourage poaching.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Determine the relative impact of poaching upon the population size of anadromous fish species.

TARGETED RESEARCH : Conduct a feasibility study of expanding the reservoir release capacity of New Don Pedro Dam.

RATIONALE: The current reservoir release capacity of New Don Pedro Reservoir is 14,500 cfs. Expanding the release capacity of New Don Pedro Reservoir could increase the flexibility of managing the flood pool. In addition to enhancing flood protection, expanding the release capacity could also provide greater energy to initiate downstream channel migration in conjunction with restoration actions intended to re-connect the river channel with its floodplain (such as setback levees or levee removal, and the purchase of floodplain land or flood easements).

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Determine the flow necessary to drive channel migration in the lower Tuolumne River, and use this flow as a target release capacity for the feasibility study.

TARGETED RESEARCH: Evaluate the feasibility of re-operating flood releases from New Don Pedro Reservoir to improve channel maintenance flows, in balance with downstream flood protection.

RATIONALE: Threshold flows of a certain magnitude are required to mobilize and distribute coarse sediments, to scour vegetation that has encroached into the active channel, and to flush fine sediments onto floodplains. Re-operating flood releases from New Don Pedro Reservoir may be able to provide flows sufficient to sustain these important ecological processes without significantly affecting water supply.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- The magnitude of channel maintenance flows will vary based upon changing conditions in: the amount and size of coarse sediments (both natural and introduced sources) available for transport and distribution; the age and density of encroaching vegetation; and the amount of fine sediments stored in the channel.

MERCED RIVER STAGE 1 ACTIONS

ACTION 1: Isolate dredger pits from the active river channel.

RATIONALE: Old gravel mining operations created large pits in Merced River floodplains. Insufficient levees designed to separate the mining pits from the river have been breached during high flow events. The dredger pits can elevate water temperatures, and they provide habitat for both native and exotic fish species that prey upon juvenile anadromous fish. Isolating these pits from the active channel could help to reduce water temperatures and the loss of juvenile fish to unnaturally high levels of predation

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- Estimate rates of predation upon juvenile anadromous and resident fish species by non-native, warm water fish species.
- Evaluate water temperatures in the channel before and after dredger pits are isolated from the main channel.
- Evaluate rates of gravel recruitment and transport before and after dredger pits are isolated from the main channel.
- Compare interaction between surface flow and groundwater flow in vicinity of isolated dredger pits with reaches not bordered by dredger pits to estimate the amount of surface water lost from the stream channel to dredger pits.

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

FY' 97 Category III funds were provided to help fill in or isolate gravel mining pits

MAINSTEM SAN JOAQUIN RIVER STAGE 1 ACTIONS

ACTION 1: Improve instream flows by purchasing water from willing sellers or providing alternative water supplies that will allow diverters to reduce diversions. (Note: this water will be part of the 100 TAF of water purchased to improve stream flows in the Sacramento and San Joaquin Basins.)

RATIONALE: Additional water is needed to augment flows on the San Joaquin River below the Merced River to provide attraction flows for adult salmonids and out-migration flows for juvenile salmonids. Additional flows may also have the benefit of diluting pollutants and reducing diversion effects in the South Delta.

ADAPTIVE MANAGEMENT CONSIDERATIONS:

- VAMP

CURRENT OR RECENT RESTORATION ACTIVITIES OR INVESTIGATIONS:

- VAMP

ACTION 2: Develop a cooperative strategy to acquire floodplain easements along the lower San Joaquin River consistent with the Sacramento and San Joaquin River Basins Comprehensive Study.

RATIONALE: The U.S. Army Corps of Engineers, the California Reclamation Board and the Department of Water Resources is conducting the Comprehensive Study to develop a strategy to reduce flood damage while incorporating ecosystem restoration through structural and non-structural measures. This is an opportunity to cost-effectively restore large expanses of ecologically important floodplains while improving flood protection by through cost sharing and integrated project design and implementation. A variety of measures including levee setbacks and riparian restoration on the mainstem San Joaquin River would meet objectives of the Comprehensive Study and the Ecosystem Restoration Program.

GENERAL SAN JOAQUIN BASIN STAGE 1 ACTIONS

ACTION 1: Acquire at least 100,000 acre-feet of water from willing sellers for environmental uses in the Sacramento Basin, San Joaquin Basin and the Delta. (Note: action also listed as Sacramento Basin action..)

RATIONALE: Alteration of the flow regime in Bay-Delta tributaries and changes in Bay-Delta hydrodynamics have contributed to ecosystem degradation. Purchasing water from willing sellers will provide water that can be used to:

- Provide passage flows for adult anadromous fish;
- Provide pulse flows for emigrating juvenile salmonids;
- Improve habitat conditions by reducing water temperatures;
- Prevent diversion effects on fish through exchange agreements with diverters;
- Provide flushing flows to maintain the quality of aquatic habitat;
- Provide flows for riparian habitat maintenance, regeneration, and succession;
- Provide flows to inundate floodplains.

This 100 TAF is not a part of CVPIA flows; rather, it is additional water necessary to meet the broader objectives of the CALFED Ecosystem Restoration Program and will be coordinated with the Environmental Water Account.